UNIMORE Dipartimento di Scienze Fisiche, Informatiche e Matematiche

UNIVERSITÀ DEGLI STUDI DI MODENA E REGGIO EMILIA

CNRNANO MODENA S3

FIM-S3 SEMINAR

Using Resonant Inelastic X-Ray Scattering to study quantum materials

Tuesday January 14th, 2025 – 11.00 (sharp)

S3 Seminar Room, 3rd Floor, Physics building
Remote link: Teams

Speaker

Jonathan PELLICIARI – Brookhaven National Laboratory (USA)

Abstract

Modern light sources like the NSLS-II at Brookhaven National Lab deliver bright tunable photons in a wide range of energies from the THz regime up to 100 keV. This allowed the development of scattering techniques relying on the use of atomic resonances enabling the access to the electronic degrees of freedom in materials. Resonant Inelastic X-Ray Scattering (RIXS) is one of these techniques and thanks to the massive development in instrumentation and theory is playing a significant role in the study of quantum materials with contributions in multiple fields such as superconductivity, quantum magnetism, 2D materials, and lately single photon emission. The sensitivity of RIXS to bosonic excitations of different nature (spin, orbital, lattice, and charge) can provide microscopic information on materials as a function of energy and momentum. In my seminar I will start by introducing RIXS its capabilities and limitations, followed by a description of the experimental components needed to perform high-resolution RIXS and the solution that we developed at Brookhaven National Laboratory. I will then move forward by highlighting two scientific cases in different fields. The first case regards the study of quantum emitters in hBN, we could unveil vibronic states and connect them to the signals detected in photoluminescence. By analyzing the pattern of the vibronic states, we could identify the N2 molecular vibrations as the key for the emergence of quantum emission. I will conclude by highlighting our studies on excitons in Nickel-based 2D van der Waals magnets where we could detect their energy, nature (atomic terms), and evolution as a function of charge transfer energy (and hybridization), and their dispersion in momentum space. Finally, I will conclude by providing some perspective on the use of RIXS in other quantum materials.

[1] Ament et al., Rev. Mod. Phys. 83, 705
[2] Fan et al., unpublished
[3] Pelliciari et al., Nat. Mat. 23, 1230
[4] Occhialini et al., Phys. Rev. X 14, 031007

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